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THE AUTHORS OF THE SEVERAL PAPERS ARE INDIVIDUALLY RESPONSIBLE FOR THE
SOUNDNESS OF THE OPINIONS GIVEN AND FOR THE ACCURACY OF THE
STATEMENTS MADE THEREIN.

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- Fig. 56.—*Trygon* cf. *rugosus*, Probst sp. *a*, Anterior aspect of tooth; *b*, posterior aspect; *c*, side view; *d*, upper surface of tooth. Mallee Bore, No. 5, 163-175 feet. × 4.
- Fig. 57.—*Myliobatis moorabbinensis*, Chapman and Pritchard. Lower or articulated surface of tooth. Mallee Bore, No. 10, 225-230 feet. × 2.
- Fig. 58.—(?) *Chrysophrys* sp. Rounded pavement tooth; with crenulated basal margin. Mallee Bore, No. 8, 210-219 feet. × 5.
- Fig. 59.—(?) *Chrysophrys* sp. Tooth with thickened basal margin. Mallee Bore, No. 3, 201-220 feet. × 4.

ART. VII.—*Further Notes on Australian Hydroids.*—III.

By W. M. BALE, F.R.M.S.

(With Plates, XI., XII., XIII.).

[Read 9th July, 1914].

ORTHOPYXIS, L. Agassiz.

Campanularia, auct., in part.

Clytia, auct., in part.

Læomedea, auct., in part.

EucopeUa, Von Lendenfeld, in part.

Agastia, Hartlaub.

Trophosome consisting of smooth or undulated peduncles of varying length, springing from a creeping hydrorhiza, and supporting each a single hydrotheca; hydrothecae campanulate, with the lower part compressed, but usually circular above, the perisarc varying much in thickness, but always greatly thickened inwards near the base so as to form a "floor" on which the hydranth is supported; hydranth radially symmetrical, with about 24-32 tentacles and a large trumpet-shaped hypostome.

Gonothecae very variable in form within the limits of a species; gonozooid a modified medusa, having neither tentacles nor digestive cavity, but provided with four branched radial canals, and sometimes with marginal sense-organs.

The sub-genus *Orthopyxis*, which was proposed by Agassiz for the reception of the single species *Clytia (Orthopyxis) poterium* (a species which had already been described by Hincks under the name of *Campanularia caliculata*), has been disregarded by later observers, most of whom have been content to rank the species under *Clytia* or *Campanularia*.

In 1883 Von Lendenfeld described as the type of a new genus and family a species which he called *EucopeUa campanularia*, and which, he claimed, was distinguished from all previously known hydroids by the possession of a gonozooid medusoid in character but totally destitute of manubrium and tentacles. Although referring to Agassiz' work he failed to notice that the characters on which he based his new genus were precisely those of the form described in great detail by the American naturalist.

In recent years several observers have, following Von Lendenfeld, admitted the genus *Eucopella*, and Fraser, recognising the affinity of *C. caliculata* with Von Lendenfeld's genus, has adopted the name *Eucopella caliculata*. No doubt Fraser is right with regard to the affinity of that species, but if such forms are to be separated from *Campanularia* or *Clytia* (as most observers seem inclined to separate them), then they must be referred to *Orthopyxis*, which was far anterior to Von Lendenfeld's genus. That *Eucopella* should be superseded is the more desirable, since much confusion has been caused by the original association under that name of two quite unrelated forms.

The most important character of the genus *Orthopyxis* is the structure of the gonozoid, which, as described by Agassiz, is a very degraded form of medusa, having an umbrella with four radial canals, but neither manubrium nor tentacles. There is also a peculiarity of the trophosome not noticed by any of the earlier observers, namely the distinctly bilateral development of the hydrotheca, which is compressed in the lower half so as to be of an elliptic or oblong section, while, as a rule, retaining the ordinary circular form in the distal portion. Another prominent characteristic, apparently common to all the species, is the variability in thickness of the hydrotheca-wall, which occurs in individuals not only of the same variety, but also of the same colony. I find this variation in thickness to be dependent, to a certain extent, on the position in which the hydrotheca is viewed; thus a hydrotheca seen in its broader aspect is not only less tapering downwards, with a wider and flatter floor, but its wall commonly appears distinctly more thickened than when it is seen in its narrow aspect. In some of the published figures of *O. compressa* the thickening of the calycle-wall is remarkably developed.

In *O. caliculata* the peduncles, which vary extremely in length, are slender, thin-walled, and twisted into a loose, irregular spiral, generally throughout their length, but sometimes with smooth or nearly smooth intervals. Most of the other forms agree in this particular, or else have the undulations shorter and more pronounced, but *O. compressa* and *O. angulata* have peduncles which are stouter in themselves, and provided with thicker perisarc, and never exhibit the spiral or undulated form found in the other species. Below the pronounced globular segment which occurs immediately under the hydrotheca in all the species, these often have a distinct oblong segment, and there may be a few constrictions at irregular intervals.

A noteworthy characteristic of the genus is the wide range of variation displayed in the forms of the gonangia. Every species has its typical form, but a large proportion of the individual gonangia differ from their respective types very considerably, distorted and irregular forms being abundant. Several species which scarcely differ at all in regard to the trophosome have nevertheless gonangia quite unlike each other.

Only in *O. caliculata* and *Eucopeella campanularia* have the gonozooids been the subject of elaborate investigations, the former by Agassiz and the latter by Von Lendenfeld. The most important distinction is the presence in *E. campanularia* of eight otocysts on the umbrella-margin. So far as is known there is no noticeable difference in any of the species between the gonangia which contain the male and the female medusae.

Perhaps the most striking point about the genus is the exceedingly close relationship existing between the various species. Except for the difference in the peduncles, which distinguishes *O. compressa* and *O. angulata* from the other forms included here, their trophosomes agree so closely that, keeping in mind the variations which exist in each species (and which will most probably be found on further investigation to be even more extensive than I have described them from the few specimens at my disposal), we would not find it surprising if all these variations were to occur within the limits of a single species. Yet the differences in the gonosomes appear ample to justify their separation. It is to be borne in mind, however, that most of these species are described from the trophosomes and the gonangia only; in none of them except *O. caliculata* and *E. campanularia* have the gonozooids themselves been sufficiently investigated to render it certain that they come strictly within the limits of the genus as it is described by Agassiz and Von Lendenfeld.

ORTHOPIYXIS CALICULATA (Hincks). (Pls. XI. and XII., Fig. 1).

Campanularia caliculata, Hincks, Ann. Mag. Nat. Hist. (2), xi., 1853, p. 178, pl. v., fig. 5. Allman, Proc. Roy. Soc. Edin., iv., 1862, p. 61, 64. Hincks, Brit. Hyd. Zooph., 1868, p. 164, pl. xxxi., fig. 2-2d. Bale, Proc. Lin. Soc. N.S.W. (2), iii., 1888, p. 755, pl. xiii., figs. 1-3. Schneider, Zool. Jahrb., x., 1897, p. 482. Thornely, Zool. Results, Willey, iv., 1900, p. 454. Hargitt, Amer. Nat., xxxv., 1901, p. 383, fig. 18. Hartlaub,

- Zool. Jahrb., Suppl. vi., 1905, p. 560, 553, 562, figs. K, L. Warren, Ann. Nat. Govt. Mus., i., 1908, p. 338, f. 19.
- Campanularia breviscyphia*, Sars, Middelhavet's Lit. Fauna, 1857, p. 158, pl. i., figs. 12-13.
- Laomedea caliculata*, Allman, Ann. Mag. Nat. Hist. (3), xiii., 1864, p. 373.
- Clytia (Orthopyxis) poterium*, Agassiz, Contr. Nat. Hist. U.S., iv., 1862, p. 297, pl. xxviii., figs. 1-20, pl. xxix., figs. 1-5.
- Orthopyxis poterium*, A. Agassiz, Catal. N. Amer. Acal., 1865, p. 81.
- Campanularia poterium*, Nutting, U.S. Fish. Comm. Bull. for 1899, 1901, p. 344, fig. 24.
- Clytia caliculata*, Nutting, Proc. Wash. Acad. Sci., iii., 1901, p. 170, pl. xvii., fig. 1-2.
- Eucopella caliculata*, Fraser, Bull. Labor. N. H. State Univ. Iowa, vi., 1911, p. 36.
- Campanularia integra*, in part, Levinsen, Vid. Meddel. fra den naturh. Foren, 1892, p. 26. Marktanner-Turneretscher, Zool. Jahrb., viii., 1895, p. 406. Birula, Ann. Mus. Zool. Acad. Sc. St. Pétersbourg, 1898, p. 3-6, fig. 1-3. Billard, Arch. de Zool, exp. et gén. (4), vii., 1907, p. 340. Jäderholm, Kungl. Svensk. Vetenskapsakad. Handling., Bd. 45, 1909, p. 65. Broch, Fauna arctica, v., 1909, p. 185, 225. Linko, Faune de la Russie, i., 1911, p. 170.
- (Not *Campanularia caliculata*, Calkins, Proc. Boston Soc. Nat. Hist., xxviii., 1899, p. 351, pl. ii., fig. 11-11c., pl. vi., fig. 11d.)

This cosmopolitan species has been often described, but all the older descriptions missed an important point in the structure of the hydrotheca, namely the bilateral development of the lower portion, which is distinctly compressed, so that the hydrothecae at this part may be said to have two broader and two narrower sides. I have generally found the perisarc of the narrower sides somewhat thicker than elsewhere, so that on viewing the hydrotheca in its broader aspect the wall appears thicker than when seen in the other direction. In a typical hydrotheca, as seen in its narrow aspect, the two sides appear as convergent lines, straight throughout, the outline in this aspect being therefore distinctly funnel-shaped. But

as seen in the other aspect the sides are less convergent down to the floor or diaphragm, below which they curve inward, making the outline bell-shaped. The thickening of the calycle-wall may be quite pronounced in the broader view, while not appearing in the narrower aspect. This thickening is generally greatest at the margin of the hydrotheca, becoming gradually less towards the diaphragm. The conspicuous inward thickening which forms the diaphragm is pierced by a central channel, or hydropore, which expands into a small rounded cavity between the diaphragm and the base of the hydrotheca. If the same hydrotheca be viewed in its narrow aspect the sides will appear quite thin, and even at the base the perisarc will not appear very thick, as the central enlargement of the hydropore appears in this view to nearly fill the space below the diaphragm. But in some colonies all the hydrothecae may appear thin-walled, in whatever direction they are viewed.

Sometimes the border of the hydrotheca may be a little everted, in other cases not at all, especially when thick at the margin. Considerable differences in size often exist among the hydrothecae of a single colony. I have not detected any sign of bilateral symmetry in the hydranths, which have a very large hypostome and from about 24 to 30 tentacles. The peduncles may be of any length, from twice that of the hydrothecae to twenty times, or even more. They are thin-walled, and twisted in a loose irregular spiral, with occasionally smooth interspaces.

The typical gonangia are oblong or ovate, tapering below, smooth, and when mature rounded at the top. They are but slightly compressed. But variations from the type are abundant; sometimes there are two inflations, corresponding to the two contained zooids, in other cases there are still more irregular forms, and there may be a series of annular undulations. Agassiz describes the gonothecae as about twice the length of the hydrothecae; in my specimens I find them three to four times as long.

Much difference of opinion exists as to whether *O. caliculata* and *C. integra* are the same species. Among those who support this view are Lexinsen, Birula, Billard, and Linko, while Hartlaub, Calkins, and Nutting hold the contrary opinion. I am at the disadvantage of not having seen Birula's paper, but I find from Linko that *C. integra, forma typica*, is distinguished by its orbicular and thin-walled hydrothecae from *forma caliculata*, in which the hydrothecae are compressed, with thick walls. This distinction obviously does not hold good, since we find the compressed hydro-

thecae of *O. caliculata* are frequently quite as thin-walled as those of *C. integra*. However, it is admitted that *O. caliculata* has the hydrothecae compressed while *C. integra* has not, and in face of that fact it would require very strong evidence to prove the identity of the two forms. It may be mentioned that Calkins claims to be able to distinguish between them by the diaphragm, which in *O. caliculata* is simply the inward thickening of the perisarc, while in *C. integra*, according to this observer, there is a special diaphragm overlying the perisarcal thickening. Broch (Bergens Museum Aarbog 1905. No. 6, p. 10, fig. 1), describes and figures this character as pertaining to *C. caliculata*, but nothing of the sort exists in any specimen of *C. caliculata* observed by me, nor indeed in any of the species ascribed in this paper to the genus *Orthopyxis*.

ORTHOPYXIS MACROGONA, (Von Lendenfeld) (Pls. XI. and XII.,
Fig. 2).

Campanulina caliculata var. *makrogona*, Von Lendenfeld,
Proc. Lin. Soc. N.S.W., ix., 1884, p. 922.

Campanularia caliculata var. *makrogona*, Bale, Proc. Lin.
Soc. N.S.W. (2), iii., 1888, p. 755, pl. xiii., fig. 4-8.
Farquhar, Trans. N.Z. Inst., xxviii., 1895, p. 459.

Hydrorhiza very stout, peduncles slightly to strongly waved, three or four times as long as the hydrothecae.

Hydrothecae very much compressed, with the aperture circular or elliptic; in the broad aspect with very wide base and with the cavity usually equally wide from the aperture to the floor, which is quite flat; in the narrow aspect with a somewhat abrupt decrease of diameter about the middle; wall-thickening in the form of a stout convex external band completely surrounding the upper half of the hydrotheca; margin plain, slightly everted. Length .28—.45 mm.; width of the broad side at aperture .22—.28 mm.

Gonothecae very large, oblong or ovate, often irregular, smooth, rounded above, very slightly compressed; length about 1.65—1.87 mm., width, .82—.90 mm. Gonophore a medusoid bud, not becoming free.

Hab.—Port Phillip (Von Lendenfeld); New Zealand (Farquhar); Bondi (Australian Museum).

The character which led Von Lendenfeld to distinguish the variety was the very large size of the gonangia, which otherwise much resemble those of *O. caliculata*, being like them, subject to extreme variation in form. They are of very firm perisarc. The hydro-

thecae are more compressed laterally than those of *O. caliculata*, and in most of them the **sides**, in the broader aspect, are not convergent, so that in this **view** the cavity appears as if perfectly **cylindrical**, with a flat floor. A much thickened annular band, convex in section, encircles the distal half of the hydrotheca completely; from the lower edge of this band to the floor the wall is less thickened. The hydrothecae frequently have the compressed condition extended in some degree to the distal portion, so that the aperture may be elliptical. The bead-like segment immediately below the hydrotheca is noticeably narrower than the peduncle on which it is supported, a feature not observable in *O. caliculata*.

The rounded summit of the gonotheca forms a convex cap, which separates at maturity. There are usually two gonozooids, which are described by Von Lendenfeld as medusoid buds, which do not become free, and in fact do not possess a properly developed umbrella at the time when the sexual products are matured. He adds that they are similar to those of *C. caliculata*.

ORTHOPIXIS WILSONI n. sp. (Pls. XI. and XII., Fig. 5).

Hydrorhiza rather slender, peduncles strongly waved, commonly 2-4 times as long as the hydrothecae.

Hydrothecae usually thin-walled, but occasionally slightly thickened, thickening principally near the top; mostly somewhat bell-shaped in the broad aspect, rather more funnel-shaped in the narrow view, with the thickening absent or scarcely indicated; border plain, very slightly everted: length, .34—.43 mm., width at aperture, .25—.33 mm.

Gonothecae very large, not compressed, sub-cylindrical, equal in diameter throughout except at the basal part, divided into about seven or eight longitudinal areas by lines which run from the summit to near the base; no operculum, irregular forms frequent. Length when mature, about 1.95 mm., diameter, .75—.87 mm. Gonophores large, medusoid, umbrella with 8 otocysts (?).

Hab.—Port Phillip (Mr. J. Bracebridge Wilson).

Many of the hydrothecae show no thickening, others appear in the broader aspect slightly thickened in the fashion of *O. caliculata*, or with a sub-marginal band in the same position as that of *O. macrogona* but much less pronounced. The two aspects differ but little, the cavity being somewhat more broadly rounded at the base in one view than in the other. The peduncles usually have the

undulations shorter and more strongly accentuated than those of *O. caliculata*. The gonangia are of very characteristic form. They roughly resemble a seven- or eight-sided prism, but the sides are curved instead of flat. The longitudinal lines are simply the optical expression of the folds in the perisarc, where the sides meet. These lines usually appear more or less irregular, being broken and wanting in parts, and in comparatively few cases are they fairly straight and uniform throughout. The gonotheca is subject to quite as many irregularities as in the allied species; I have seen examples with a deep constriction round the middle, and others with a series of irregular annulations. **The sexes do not differ in form.** There are two medusae, one of which may be so large as to nearly fill the capsule, while the other is still very small. In one case I saw what seemed to be otcysts.

The absence of a distinctly compressed condition of the gonangia differentiates this species from all the others referred to in this paper.

ORTHOPIXIS PLATYCARPA n. sp. (Pls. XI. and XII., Fig 3).

Hydrorhiza stout, peduncles distinctly waved, mostly 2-4 times as long as the hydrothecae.

Hydrothecae large, wide-based in the broader aspect, with the walls often somewhat thickened, principally in the form of a convex sub-marginal band, narrower aspect less thickened or not at all, border plain, distinctly everted. Length, .33—.43 mm., width at border, .32—.39 mm.

Gonothecae large, very much compressed, smooth, with straight sides forming angles at the summit, which is slightly lower between them, a single gonophore filling the capsule when mature. Length, about 1.55 mm., width .72—.90.

Hab.—In or near Port Phillip.

This form, in the strongly compressed hydrothecae, the broad basal portion, and the form of the thickening, shows most affinity with *O. macrogona*, and occasionally a hydrotheca is seen which might readily be taken for one of that species. The gonangia, however, differ greatly in their straight sides and squarish summit (as seen in their broader aspect), and in their much compressed form. Seen edge-wise they appear slightly curved alternately in opposite directions. In each of the few specimens which I examined there was a single large gonophore, occupying the whole cavity, but they were not in a condition to permit of their character being made out satisfactorily.

I have seen but few gonangia, and cannot say what may be the extent of their habitual variation. Those which appear typical somewhat resemble those of *O. angulata*, but that species is readily distinguishable from the present by its smooth peduncles.

ORTHOPTYXIS COMPRESSA Clark.

Campanularia compressa, Clark, Proc. Acad. Nat. Sci. Philad., 1876, p. 214, pl. viii., fig. 5, 6. Hartlaub, Zool. Jahrb., Suppl. vi., 1905, Bd. iii., p. 562, fig. M, Linko, Faune de la Russie, Hydroidea, i., 1911, p. 172, fig. 29.

Clytia compressa, Nutting, Proc. Wash. Acad. Sci., iii., 1901, p. 170, pl. xvii., fig. 3, 4. Vanhöffen, Deutsche Südpolarexp. 1901-3, xi., Zool. iii., 1910, p. 303, fig. 24-24e.

Eucopella campanularia, Von Lendenfeld, Zeitschr. f. wiss. Zool., xxxviii., 1883, pp. 497-583, pl. xxvii-xxxii. (but not pl. xxix., fig. 15, D1, D $\frac{1}{2}$).

? *Campanularia caliculata*, Calkins, Proc. Bost. Soc. Nat. Hist., xxviii., 1899, p. 351, pl. ii., fig. 11-11e, pl. vi., fig. 11d.

? Not *Campanularia compressa*, Jäderholm, Schwedischen Südpolarexp. 1901-3, v., 1905, p. 14, pl. v., fig. 6, 7.

Not *Clytia compressa*, Torrey, Univ. Calif. Publ., Zoology, i., 1902, p. 58, pl. vi., fig. 49.

O. compressa has the hydrothecae of the same type as those of *O. caliculata*, but they have the perisarcal thickening more pronounced. Most observers figure thick-walled and thin-walled hydrothecae, which are probably different aspects of the same individual. The chief distinction between this species and *O. caliculata* is in the peduncles. These in *O. caliculata* are twisted in a somewhat irregular spiral; the undulations may fail here and there, but are rarely absent altogether. In *O. compressa* the stalks are much stouter, with thicker walls, while they are never undulated, though they may be divided, especially near the hydrotheca, by several distinct constrictions. Their thick perisarc appears narrowed in at the point of origin, so that their diameter at this point is little more than that of the internal canal, and altogether they closely resemble those of the genus *Silicularia*.

Various forms of gonangia have been figured, some cuneate, others more elongated; Clark describes them as "largest at the

distal end, rounded at the base, very much compressed laterally." Vanhöffen's and Linko's figures show them with the perisarc very much thickened towards the base, exactly as in those of *Silicularia reticulata* (Hartlaub), which they also resemble in their cuneate outline.

Contradictory accounts of the species are given by different observers. Nutting, Hartlaub, Vanhöffen, and Linko appear to have seen specimens agreeing with Clark's. Calkins describes under the name of *Campanularia caliculata* a form of which the trophosome, according to his account, agrees exactly with that of *O. compressa*, not with that of *O. caliculata*. At the same time the gonangia which he figures are more like those of the latter species. Torrey describes specimens of which the medusa has four long tentacles, as however the hydrothecae have a toothed margin, which never occurs in *O. compressa*, it is difficult to see why they are referred to that species. The form given as *C. compressa* by Jäderholm has ringed or twisted peduncles, and therefore seems wrongly placed; the gonotheca moreover is more like that of *O. caliculata*. As Vanhöffen states, the species is characterised by the thick hydrothecae, the smooth stalks, and the broad flat gonothecae.

In ranking *Eucopella campanularia* Von Lendenfeld as a synonym of *O. compressa* I follow Nutting, who has pointed out in his paper on the Hydroids of the Harriman Alaska Expedition that there appears to be no difference between the two species. *E. campanularia*, however, has been involved in some confusion owing to Von Lendenfeld's having included in his account of the species two forms differing entirely in regard to the hydrothecae, though the gonangia are similar. He has figured a number of hydrothecae which he says are connected by intermediate forms; most of these are of the ordinary *Orthopyxis* type, but two among them are of totally different form, and are obviously identical with those found in the genus *Silicularia*. No intermediate forms between these and the *Orthopyxis* are shown. In 1886 I received from the Australian Museum a portion of the type specimens of *E. campanularia*, which consisted solely of the *Silicularia*-forms, and were similar to those figured by me as *E. campanularia* in the Proceedings of the Linnean Society of N.S. Wales for 1888. I had not then seen Von Lendenfeld's original paper, and was not aware that any other form had been included in the species. Neither in the type specimens sent to me nor in any others of similar character which I have examined, is there any approach to the *Orthopyxis* type, while colonies of the

latter invariably fail to exhibit any hydrothecae with characters tending towards the *Silicularia* form. The distinction between the trophosomes is absolute, and I consider it beyond a doubt that *Eucopella campanularia*, as originally described, comprises two distinct species, one a typical *Orthopyxis*, the other, at least so far as the trophosome is concerned, a typical *Silicularia*.

The account of the gonangia of *E. campanularia* is contradictory, their length being stated as from two to three millimetres, while they are figured as under .75 mm.; but their compressed condition and their cuneate outline, as seen in their broader aspect, are quite similar to the same features in the typical *O. compressa*. Only, therefore, in the event of future research revealing some important difference between the gonozooid of that species and Von Lendenfeld's description will be possible to maintain the specific distinctness of *E. campanularia*.

O. compressa is found in North and South America, where, like Von Lendenfeld's specimens, it appears to grow habitually, if not exclusively, on *Laminaria*.

ORTHOPYXIS ANGULATA, n. sp. (Pls. XI and XII., Fig. 4).

Hydrorhiza thick and broad, peduncles stout, with thick perisarc, smooth, occasionally with one or more distinct constrictions, narrowed in at the base.

Hydrothecae, in the broader aspect, very wide at the base, with the floor somewhat flattened, often more or less thickened, thickening sometimes confined to a convex band surrounding the distal portion of the hydrotheca, sometimes extending to the base; narrow aspect funnel-shaped, with thin walls, except for a slight thickening where the sub-marginal band extends to them; margin plain, everted. Length, .36—.45 mm., width at aperture, .27—.37 mm.

Gonothecae broad, much compressed, the broad aspect ovate, truncate, with edges undulated; a little narrowed in near the top, and then widening outward and upward, forming angular projections at each side of the top; or even produced into blunt, horn-like processes, summit of the gonangium straight or slightly concave between them. Length, about 1.27—1.36 mm., width, .87—.96 mm. Two gonophores in each gonotheca; umbrella with four branching radial canals; and eight otocysts.

Hab.—Port Phillip (Mr. J. Bracebridge Wilson).

This species agrees with *O. compressa*, and differs from the other forms here described, in the stout, thick-walled, smooth peduncles.

The hydrothecae as seen in the broader aspect, are wider-based than any other form except *O. macrogona*, with the wall often considerably thickened at the border, and continuing fairly thick down to the base; or in some cases the thickening is confined to the upper part, forming a convex band like that of *O. macrogona*, but not so pronounced. The narrow aspect is funnel-shaped, with no thickening except a very slight one in the sub-marginal region. The border generally rises a little above the thickened part, and is distinctly everted.

The gonangia are broad, but rather short, their height averaging about 1.3 mm., and their width .90. They are ovate, truncate above, and much compressed; in the broad view the edges are undulated, curving inward near the top, and then outward, forming where they meet the top blunt angles, which are usually produced somewhat cutward and upward. The summit of the gonangium is slightly concave or nearly flat, and so narrow that an end view would be lanceolate rather than elliptic. **Irregular forms are found**, but most of those examined were normal. Two gonozooids are contained, pretty closely packed, the lower one larger in proportion to the upper than is usually the case, and lying obliquely to it. The only gonangia seen contained male gonozooids. The eight ootocysts of the medusa were very distinct.

A very close affinity exists between the present species and *Eucopeella campanularia* Von Lendenfeld (which is discussed under *O. compressa*). The principal difference is in the form of the gonangia, which are distinguished from those of *E. campanularia* by the broader lower portion, the undulated outline, and particularly by the prominent superior angles.

SILICULARIA, Meyen.

Hypanthea, Allman.

Eucopeella, in part, Von Lendenfeld, Hartlaub.

Allman's description of the genus *Hypanthea* is as follows:—"Hydrothecae pedunculate, inoperculate, with walls enormously thickened, and so far encroaching upon the cavity as to render impossible the complete retraction of the hydranth. Gonosome—Gonangia enclosing fixed sporosacs." The species were further characterised by the possession of bilateral hydrothecae, with oblique apertures. A more recently described species, however,—*S. divergens* Hartlaub—differs from all the others in having the hydrothecae regular, with a large cavity, and apparently resembling those of

Orthopyxis. Probably these may be bilateral to the same extent as those of *Orthopyxis*; in any case they seem to form a distinct link between the two genera.

As stated under *O. campanularia* Von Lendenfeld included under that species two distinct hydroids, an *Orthopyxis*, and a *Silicularia*, the latter of which is here distinguished under the name of *S. campanularia*.

In considering the relations of *Orthopyxis* and *Silicularia* we must not overlook the different structure of the hydranths. Those of *Orthopyxis* are, so far as an ordinary examination can disclose, purely radial, while some species at least of *Silicularia* are distinctly bilateral, as described by Hilgendorf in his *H. asymmetrica*, and as they exist in Von Lendenfeld's specimens, and are indicated by Hartlaub in *E. reticulata*. A large lobe or inflation occupies that side of the hydrotheca, which is lower than the rest, apparently to accommodate it, and as all species of *Silicularia* (except *S. divergens*), also have one side lower, it is presumable that the structure of the hydranth is similar in all of them. Another peculiarity in our specimens is the union of the proximal part of the tentacles in a sort of calyx with an annular, thickened border, and of this also there is a distinct indication in Hartlaub's figure of *E. reticulata*.

SILICULARIA CAMPANULARIA (Von Lendenfeld). (Pl. XIII,
Figs. 1-6).

Eucopella campanularia, in part, Von Lendenfeld, Zeitschr. f. wiss. Zool., v., 1883, p. 497-583; pl. xxix., fig. 15, D1, D $\frac{1}{2}$.

Eucopella campanularia, Bale, Proc. Lin. Soc. N.S.W., (2), iii., 1888, pl. xiii., figs. 9-15. Mulder and Trebilcock, Geelong Naturalist, (2), vi., 1914, p. 9, pl. ii., figs. 8-11.

? *Eucopella reticulata*, Hartlaub, Zool. Jahrb., Suppl. vi., iii., 1905, p. 569, fig. R¹.

Hydrorhiza very broad and thick-walled, with numerous branches, which are mostly given off at right angles, and are commonly opposite. Peduncles very stout, and with thick perisarc, the longer ones sometimes a little attenuated in the middle, rounded at the top, and narrowed in at the base, one or two rounded or oblong segments sometimes at the top, a distinct rounded or angular bead between the peduncle and the hydrotheca.

Hydrothecae much compressed, the two broad sides forming erect convex lobes, the intermediate sides lower, forming two lips, one lower than the other; the interior nearly filled up with solid perisarc, pierced by the hydropore, which is enlarged just above its lower extremity, and gradually widens out above into the shallow cavity of the hydrotheca.

Gonothecae usually decumbent, cuneate, compressed, rounded at the top when mature, shortly but distinctly stalked, their perisarc thickened towards the base.

Hydranths seated in the concavity of the hydrothecae, base flattened, a large rounded retractile inflation of that side of the body which is over the lower lip; proximal portion of the tentacles united and joined by an annular band into a calyx surrounding the oral extremity.

Gonophores—sporosacs, one or two in each gonotheca.

The foregoing description refers to the specimens which formed part of Von Lendenfeld's types of *Eucopeella campanularia*, and which, as already mentioned, were sent to me from the Australian Museum. The description applies equally to the two forms from Bondi figured by me in the Proceedings of the Linnean Society of New South Wales, under the name of *E. campanularia*. There are slight differences among these forms, and as there may be a doubt as to whether they should all be classed together, I now figure the actual specimens taken from Von Lendenfeld's types. The relationship between these three forms, also *Eucopeella reticulata* Hartlaub, is very close.

In Von Lendenfeld's specimens the hydrorhiza is extremely broad, reaching about .33 mm., of which the internal cavity occupies about .15 mm. When torn off and turned edgewise it is seen to be much flattened. The peduncles also are very massive, the longer ones may be attenuated in the middle portion, owing to the perisarc being thinner, but near the extremities they usually reach their normal diameter. The canal gradually widens a little to the base, and as the perisarc is narrowed in at the same part, the area of attachment is slender. Just at the top of the peduncle there is a distinct internal inflation of the canal. The bead-like segment between the hydrotheca and the peduncle may be globular, or it may be angular round the equator, and sometimes there is a second, and larger, globular bead. The peduncles may be tumid at the top and bottom, and their length is variable, some being less than twice the length of a hydrotheca, others ten times that length, but short ones predominate.

The hydrothecae were figured by Von Lendenfeld as obliquely truncate, like those of *H. aggregata* Allman, but the figure is inaccurate, the broader sides being elevated convex lobes. The two lips are not everted. As seen broadside the outer lateral contours are usually, but not always, slightly concave in the middle, and in the longer one there may be a slight angle. Their length varies between .30 and .55 mm., the width from .30 to .45 mm. The gonangium is flattened at the top during its growth, but at maturity the top is smoothly rounded, and firmly chitinous; there is no special border, and only by close inspection can a line be detected at which the convex top ultimately separates. They are about 1.35—1.60 mm. in length, and .75—.90 in width.

The hydranths, which I have seen only in Von Lendenfeld's specimens, are very characteristic, and quite unlike those of *Orthopyxis*, the body having on one side a large rounded inflation, which is situated just inside the lower lip. In all the hydranths, as preserved, the body was bent over the higher lip, and in close contact with it to the edge; on the opposite side is the lateral inflation, which, when fully expanded, fills in the space above the lower lip; it is sometimes retracted to small dimensions, but more often expanded sufficiently to be a conspicuous feature. Hilgendorf describes a similar lobe in his *Hypanthea asymmetrica*, but mentions that it is divided by a sharp constriction from the body, a character which I have not detected in my specimens. Hartlaub clearly indicates the lateral inflation in his figures of *Eucopella reticulata*.

The base of the hydranth is flattened; one edge of it fits into a notch or sinuation half-way down the inside of the hydrotheca, below the higher lip, the other rests on the lower side, opposite to it.

The distal portion forms a wide infundibuliform expansion or calyx, composed (at least, in regard to its outer layer) of the united proximal portions of the tentacles, and bordered by a thick, annular band, which is attached by its inner margin to the edge of the calyx; outside this circle of attachment the tentacles are free. The annulus is evidently the homologue of the hypostome of *Orthopyxis*, but it is narrower and situated further from the centre, and the fact that it is constant in position in all the hydranths conveys the impression that it has not the mobility of the hypostomes of *Orthopyxis*, which assume all sorts of varied degrees of expansion and contraction. Occasionally in a slide of *Orthopyxis* is seen a hydrotheca, with the tentacles recurved, and the hypostome ex-

panded to its utmost limit, and such a one presents a strong resemblance to the specimens before us. Possibly the treatment to which they have been submitted may have caused them to become fixed in an unusually widely expanded attitude, and may in part account for the characteristic form. I have, however, some specimens of a New Zealand species, in which the condition is similar, and Hartlaub's figure of *Eucopeella reticulata* gives a distinct indication of the annular band. An allied species, described by Mulder and Trebilcock as *Eucopeella undulata* (Geelong Naturalist, May, 1914), also appears to have the same structure.¹

Unfortunately, the specimens, probably from the action of a reagent, are excessively dark and opaque, so that I was unable to ascertain the structure satisfactorily, especially the condition of the oral region. In some cases there seemed to be a dome-like elevation in the middle of the calyx, in others it was not apparent. The annulus lies flat, and the tentacles spring horizontally from below it, and are mostly recurved. In one or two cases they were curled inwards over the annulus, which was not at all retracted. As in many Campanularians a biserial arrangement of the tentacles is indicated by their occasional alternate elevation and depression.

The gonothecae are, as Hartlaub says of those of *Eucopeella reticulata*, "ham-shaped," rounded at the top when mature, and without distinct operculum. In Von Lendenfeld's specimens some of them contained the gonophores, which were so blackened that their structure could not be made out. One of my Bondi specimens included gonophores in various stages, some of the gonothecae being closely packed with the developing ova. In most cases there were two gonophores. The perisarc of the gonotheca is thicker towards the base, often excessively so. Hartlaub describes the gonotheca of *E. reticulata* as passing into the peduncle gradually, and without distinct constriction or interruption. While none of my specimens quite agree with this, some of them are but slightly contracted at the base; in others, however, the contraction is extremely abrupt. I cannot attach much importance to this character, as the specimens vary greatly in regard to it; moreover, the position in which the gonothecae are viewed has much to do with their apparent form, as they are commonly more or less bent at the base, and decumbent.

¹ In both the species referred to the lateral inflation of the hydranth is evident, as also is the position of the upper portion, that is, leaning over the upper lip of the hydrotheca, and Mulder and Trebilcock say that is the customary attitude during life. In all the species the greatest diameter is across the annular band.

The form from Bondi, figured by me in the Proceedings of the Linnean Society of New South Wales for 1888 (pl. 13, figs. 9-11), corresponds pretty closely with Von Lendenfeld's specimens in size and habit, but differs in the very regularly convex outline of the hydrothecae, recalling, in the shorter ones, Allman's *H. hemispherica*. The base of the gonotheca is mostly broadly rounded, but sometimes narrows more gradually into the peduncle. This form may be provisionally distinguished as var. *rotunda*, but I think it quite probable that the characteristic outline of the hydrothecae may be an inconstant feature; if so, the specimens cannot be dissociated from the type.

The other Bondi form (Proc. Lin. Soc. N.S.W., 1888, pl. 13, figs. 12-15), is of more robust habit, with larger hydrothecae, and stouter peduncles. The hydrorhiza is about as wide as that of the type, but with the internal channel wider. Its lateral branches, most of which are exactly at right angles, are excessively numerous. The hydrothecae may attain the length of about .60 mm., and their lateral contours, as seen in the broader aspect, are somewhat concave, so that the lips appear slightly everted. The internal sinuation, in which the foot of the hydranth rests, is not very deep. The outside is characteristically marked, with irregular raised veins, giving it a woody appearance. It may be distinguished as var. *venosa*.

Eucopella reticulata Hartlaub differs from my specimens mainly in the gonangia, which are attenuated more gradually into the peduncles, and in the size of the hydrothecae, which reach over .75 mm. in length, while those of *S. campanularia* rarely reach .50 mm., and the average is about .40. Hartlaub's description of the hydrorhiza as wide-meshed scarcely applies to that of the present species.

The forms here described, while agreeing closely with some other species in regard to the trophosome, may readily be distinguished by the gonothecae. Whether the three Australian forms are properly referred to a single species is perhaps questionable, and further investigation must decide; but undoubtedly each of them exhibits occasional resemblances to the others, as in the size and form of the hydrothecae, the presence of veining, and other characters. The thick perisarc of the hydrothecae seems to vary greatly in density, and it is probable that much of the difference between those of var. *rotunda* and var. *venosa* (the two extremes) may be simply due to varying degrees of contraction of the perisarc, caused by the

conditions of growth. And with regard to *E. reticulata*, the characters ascribed to it seem hardly sufficient to justify its specific separation.

Hilgendorf says that the specimens figured by me as *E. campanularia* are *H. bilabiata* (Coughtrey). Of this I am very doubtful. The gonangia of *H. bilabiata*, according to both Coughtrey and Hilgendorf, are very unlike those of the present form. Hilgendorf's account of *H. bilabiata* is not in accord with his figure, especially as regards the peduncles. His specific diagnosis is a copy of Allman's description of *H. aggregata*, including the measurement ($\frac{1}{4}$ inch), but he gives the height afterwards as $\frac{1}{2}$ inch, which agrees with Coughtrey's. The present species does not, I think, reach more than half that height, and I suspect that *H. bilabiata* may be identical with the New Zealand form previously referred to, which has the hydrothecae and hydranths much larger than those of *S. campanularia*, and agrees well with Coughtrey's figure. Neither Coughtrey nor Hilgendorf give any indication of the size of the hydrothecae in their specimens. The former, it is true, says that his figures are magnified fifty times, but there is clearly some mistake, as it is obvious to anyone acquainted with some of the species figured that the magnification is not nearly fifty; in some cases, indeed, it is not twenty.

SILICULARIA UNDULATA (Mulder and Trebilcock).

Eucopella undulata, Mulder and Trebilcock, Geelong Naturalist (2) vi., 1914, p. 10, pl. ii., figs. 5-7.

This appears to be a different species from *S. campanularia*, being distinguished by the peduncles and the gonothecae. The former are thin-walled and undulated, as in most of the species of *Orthopyxis*, though often becoming thicker and smooth at both extremities. According to the figures the base is not contracted at the junction with the hydrorhiza, as in *S. campanularia*. The gonothecae are decumbent, roughly orbicular in outline, flat beneath, convex above, with faint, transverse rugae, and with a sub-circular aperture, looking upward. The hydrothecae are similar to those of *S. campanularia*.

A figure of the hydranth shows it leaning over the higher lip of the hydrotheca, which is stated to be its position when living; the inflation of the opposite side is noticeable, and the oral calyx and the annulus are also shown. As the latter is described as a large cup-shaped proboscis, it would seem that its character is more dis-

tinct than in the mounted specimens of, *S. campanularia*. The tentacles are longer than those of that species, a difference also perhaps dependent on the condition of the specimens.

ZYGOPHYLAX RUFA Bale.

Campanularia rufa, Bale, Cat. Aust. Hyd. Zooph., 1884, p. 54, pl. 1, fig. 1; Trans. and Proc. Roy. Soc. Vict., xxiii., 1887, p. 91.

“*Campanularia*” *rufa*, Levinsen, Vidensk. Medd., fra den naturh. Foren, 64, 1913, p. 292.

This species was ranked by Billard as a synonym of *Lictorella antipathes* (Lamarck), but erroneously, as I gather from the same observer's remarks in his report on the British Museum collection, in which he says that *L. antipathes* does not exhibit the slight distal narrowing of the hydrotheca, nor the everted margin, both of which features characterise the present species (as mentioned in the original description). It may also be noted that *L. antipathes* is described as a coarse, woody, and rigid form, reaching according to Lamarck and Allman about four inches, and according to Billard fourteen centimetres, while Ritchie says that some of the specimens of which he obtained portions must have much exceeded these dimensions. *Z. rufa*, so far as it is known, is a small, delicate form, under an inch in height, with the fasciculation limited to a few tubes on the stem only. The original *Lafoëa halecoides* of Allman (1873) seems to resemble *Z. rufa* more than does *L. antipathes*, but it differs in the absence of a perisarcial diaphragm in the hydrotheca. The nearest species to *Z. rufa* would seem to be *Lictorella concinna* Ritchie (Mem. Aust. Mus. iv., p. 823), which is of similar habit, but its hydrothecae differ in form, especially in the much elongated stalk-like condition of the proximal part, which is below the diaphragm.

The pinnae of *Z. rufa* are sub-alternate; between every two on the same side are two hydrothecae, one of them axillary. The apophyses are distinct, and mostly about double the diameter of the hydrotheca at the point of attachment. There is usually no intervening segment, though in exceptional cases such a segment may occur. The portion of the hydrotheca below the diaphragm or “floor” is short, generally about one-sixth of the whole length. In a few cases the apophyses which support the axillary hydrothecae are narrowed down gradually to the diameter of the hydrotheca-base, and not divided from the latter by a distinct joint.

Levinson remarks that the sub-marginal band is doubtless due to a regeneration; the fact, however, that it is always present, and is constant in its position, seems in itself sufficient to negative that view. It is, like the marginal band, a thickened ridge surrounding the hydrotheca internally, and it not uncommonly corresponds to a slight external constriction. It varies in the extent to which it is thickened, being sometimes feebly developed, especially in the newly-formed hydrothecae; and in any case, it is somewhat less robust than the border-thickening, at least in the vicinity of the four marginal points. The marginal band is at least as strongly marked at these points as elsewhere, the secondary band does not usually form pronounced points like the marginal one, but is more bluntly rounded at those positions.

The hydrotheca is without a fully-developed diaphragm, but there is an internal perisarcal ring just above the base. Higher up there is a zone of thinly scattered bright points.

EXPLANATION OF PLATES.

PLATE XI.

- Fig. 1.—*Orthopyxis caliculata* (Hincks).
 Fig. 2.—*Orthopyxis macrogona* (Von Lendenfeld).
 Fig. 3.—*Orthopyxis platycarpa*, n. sp.
 Fig. 4.—*Orthopyxis angulata*, n. sp.
 Fig. 5.—*Orthopyxis Wilsoni*, n. sp.
 (All magnified 40 diameters).

PLATE XII

- Fig. 1.—*Orthopyxis caliculata* (Hincks).
 Fig. 2.—*Orthopyxis macrogona* (Von Lendenfeld).
 Fig. 3.—*Orthopyxis platycarpa*, n. sp.
 Fig. 4.—*Orthopyxis angulata*, n. sp.
 Fig. 5.—*Orthopyxis Wilsoni*, n. sp.
 (All magnified 20 diameters).

PLATE XIII.

Fig. 1.—*Silicularia campanularia* (Von Lendenfeld), type.

Fig. 2.—*Silicularia campanularia* (Von Lendenfeld), var. *venosa*, n. var.

Fig. 3.—*Silicularia campanularia* (Von Lendenfeld), var. *rotunda*, n. var.

(All magnified 40 diameters).

Fig. 4.—*Silicularia campanularia* (Von Lendenfeld), var. *venosa*, n. var.

Fig. 5.—*Silicularia campanularia* (Von Lendenfeld), type.

Fig. 6.—*Silicularia campanularia* (Von Lendenfeld), var. *rotunda*, n. var.

(All magnified 20 diameters).

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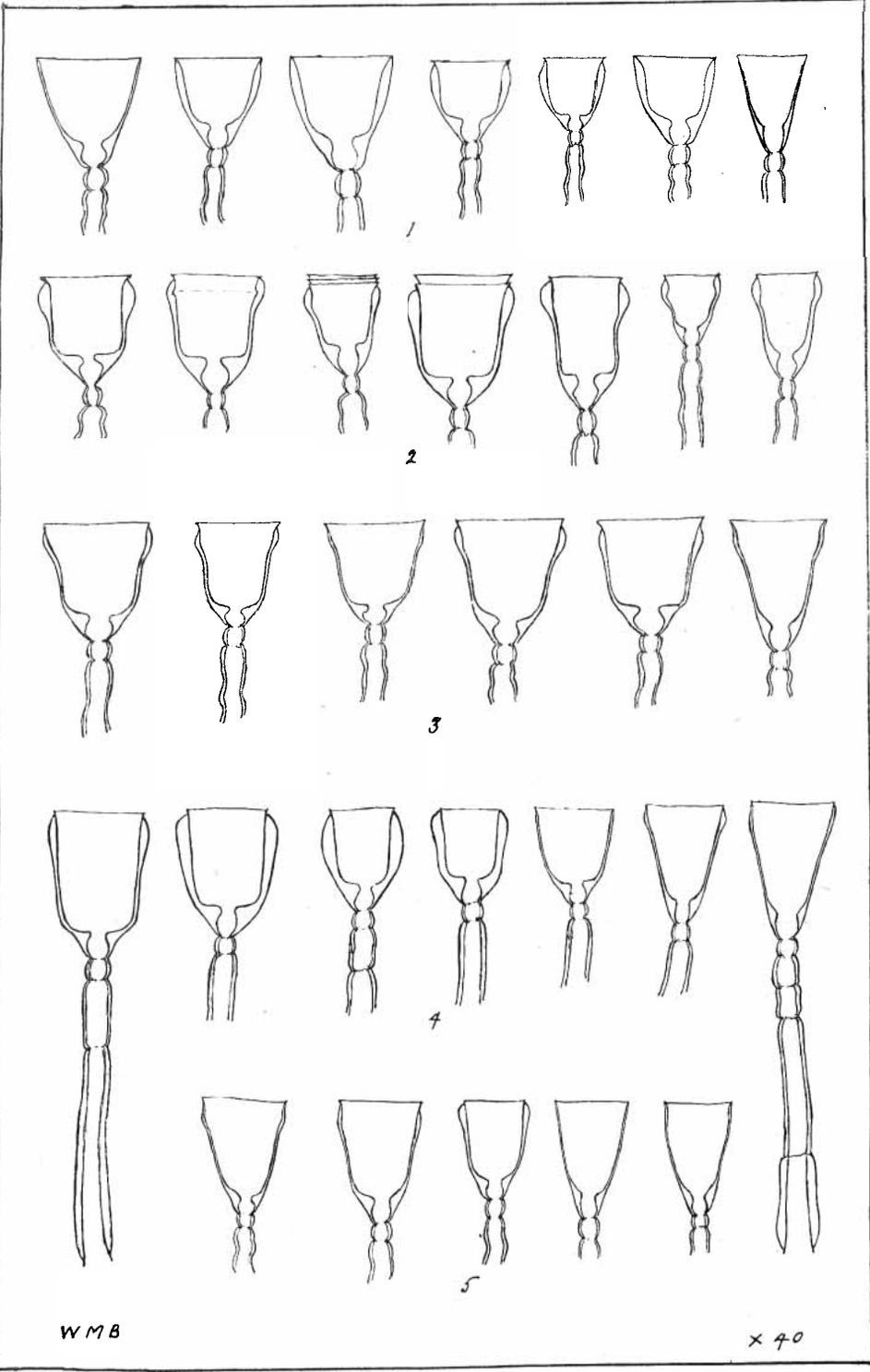
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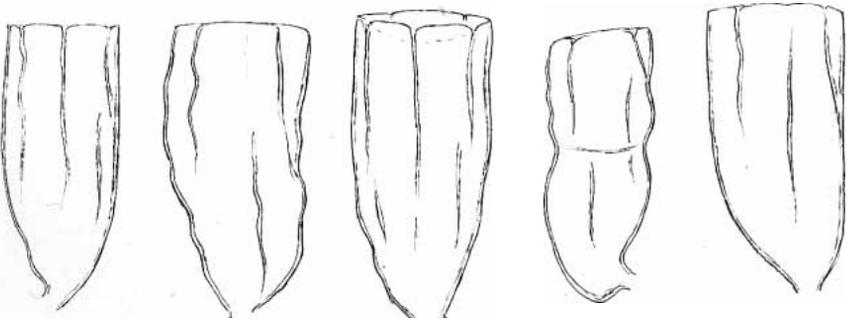
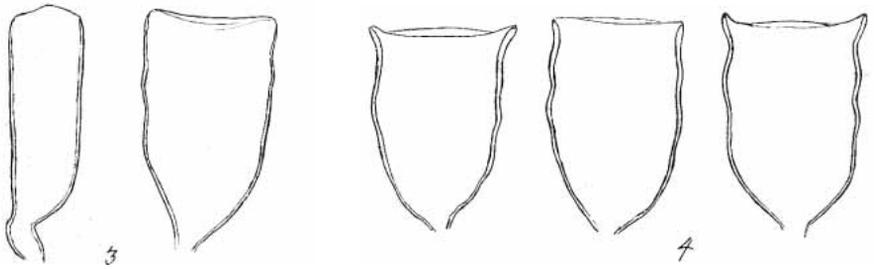
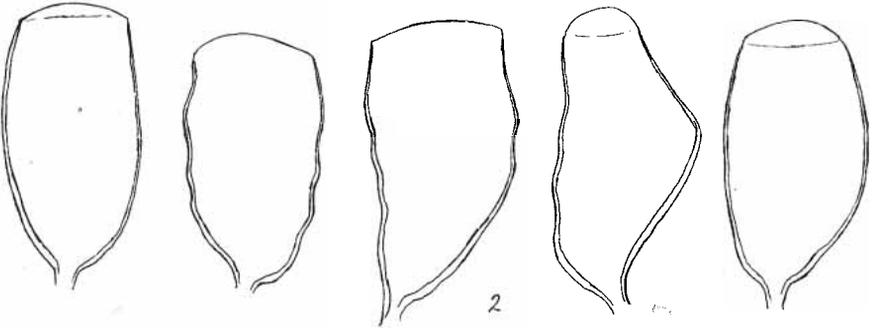
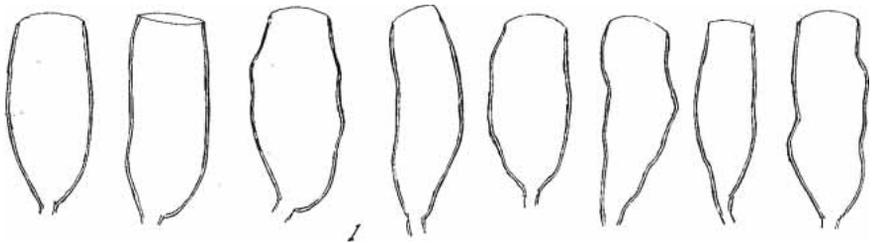
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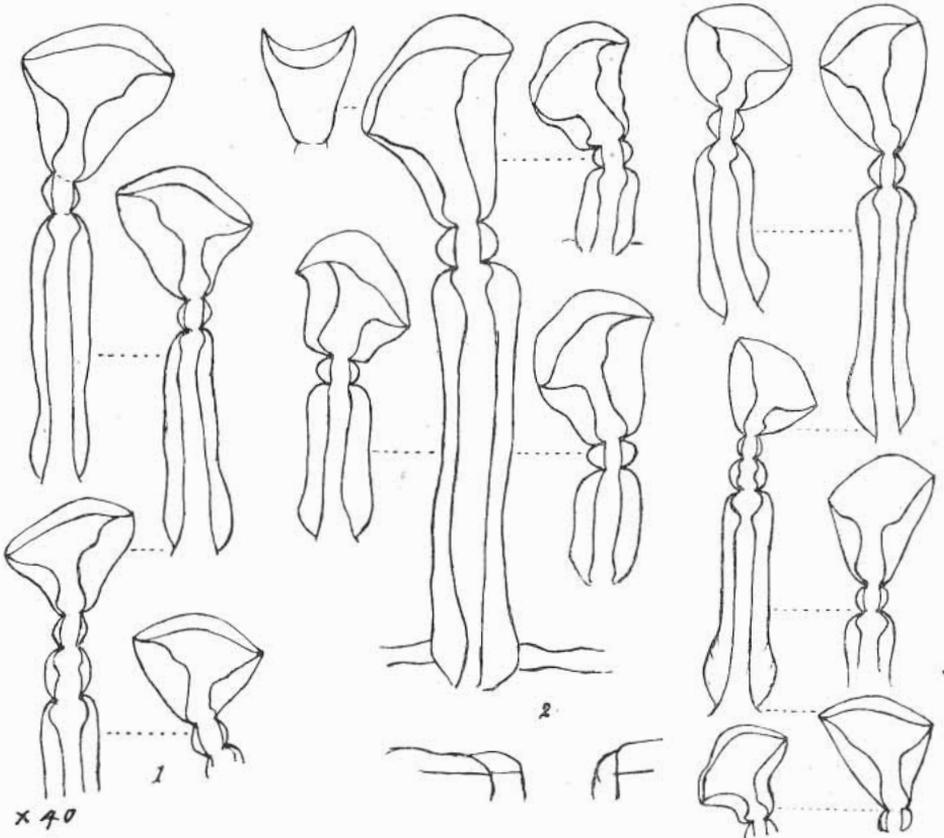
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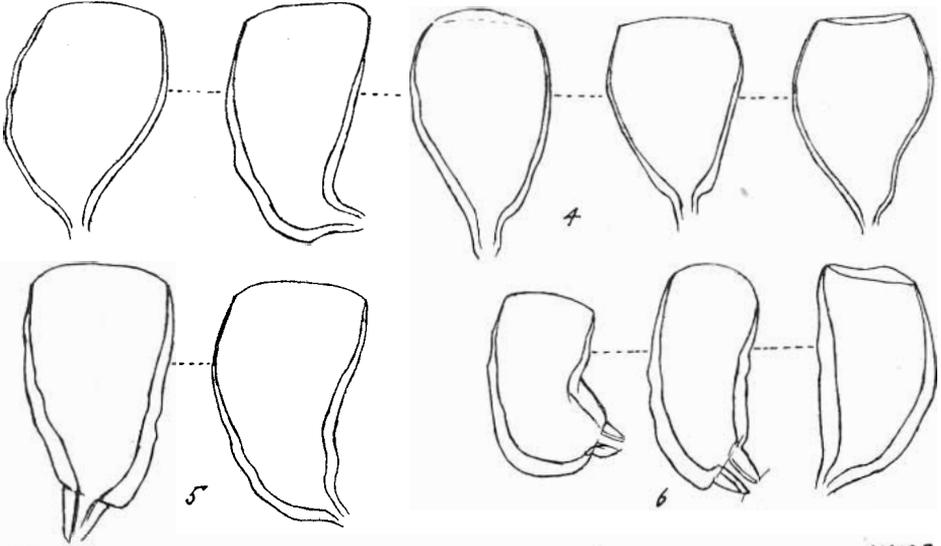
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